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REMARKS

Claims 8-27 are pending.

Claims 8-11, 16, and 19-25 stand rejected under 35 U.S.C. 102(b) as being anticipated by Yamazaki (PN 4,559,552).

Claims 8-11, 14, 16 and 19-25 stand rejected under 35 U.S.C. 102(b) as being anticipated by Howe (PN 4,521,800).

Claims 12-15, 17-18 and 26-27 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Yamazaki in view of Nakamura et al. (5,563,422).

Claims 12-15, 17-18 and 26-27 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Howe in view of Nakamura et al.

These rejections are respectfully traversed and reconsideration is respectfully requested.

Claim Rejections under 35 U.S.C. 102

Claims 8-11, 16 and 19-25 stand rejected under 35 U.S.C. 102(b) as being anticipated by Yamazaki (PN 4,559,552). In addition, claims 8-11, 14, 16 and 19-25 stand rejected under 35 U.S.C. 102 (a) as being anticipated by Howe (PN 4,521,800). Applicants respectfully traverse these rejections for the reasons stated below.

Applicant has amended claim 8 to more clearly identify a novel aspect of the present invention. Specifically, claim 8 has been amended to recite that ohmic contact comprises a layer of p-type semiconductor oxide and metal in a condition of mixed morphology. This limitation is supported by the language found on page 4, lines 18-24 and page 9, lines 4-6 of the specification. In addition, this embodiment of the present invention is illustrated in Fig. 1 of the application.

As amended, claim 8 recites "[a]n ohmic contact in a semiconductor device which is formed on a p-type semiconductor material, the ohmic contact comprising a layer of **p-type semiconductor oxide and metal in a condition of mixed morphology.**"[emphasis added]. This embodiment is illustrated in Fig. 1 of the application.

Yamazaki teaches an electrode 2 comprising a first light transparent conductive layer 3 and a second light transparent conductive layer 4, where layer 3 is formed of indium oxide containing tin oxide and layer 4 is formed of tin oxide containing antimony oxide. See col. 4, lines 16-25. Yamazaki also teaches an electrode 61 comprising a light transparent conductive layer 61 formed of a metal oxide, for example indium oxide singly or mixed with antimony oxide, and a reflective conductive layer 63 formed of metal. (See col. 8, lines 46-65)

Yamazaki does not anticipate claim 8 because it does not teach a layer of p-type semiconductor oxide and metal <u>in a condition of mixed morphology</u>. In electrode 2, both layer 3 and layer 4 are comprised of a mixture of two metal oxides, as opposed to a mixture of a metal oxide and a metal. In addition, none of the materials contained in layers 3 and 4 are **p-type semiconductor oxides**. Applicant emphasizes once again that indium oxide, tin oxide and antimony oxide are all **n-type semiconductor oxides**. In electrode 61, the metal oxide and metal are segregated into separate layers as opposed to being in a condition of mixed morphology. Furthermore, the metal oxides disclosed by Yamazaki are all **n-type semiconductor oxides.**

Howe teaches a multilayer photoelectrode comprising an insulating layer and a conductive layer.. Howe discloses a large number of materials suitable for each of these segregated layers. However, Howe does not anticipate claim 8 for at least the reason that it does not teach a layer of p-type semiconductor oxide and metal <u>in a condition of mixed morphology</u>.

As neither Yamazaki nor Howe teach all of the limitations found in claim 8, it is Applicants' belief that this claim is allowable over the cited art. Insofar as claims 9-15 depend from claim 8, it is Applicants' belief that these claims are also allowable.

Claim 16 recites "[a]n ohmic contact in a semiconductor device, which is formed on a semiconductor material, the ohmic device comprising a layer of p-type semiconductor oxide and a conductive layer."

As mentioned above, Yamazaki does not teach a layer of **p-type semiconductor oxide**. It is therefore Applicants' belief that claim 16 is not anticipated by this reference.

The Examiner also contends that Howe (PN 4,521,800) discloses an ohmic contact (12 and 14 in the Figure) in a semiconductor device which is formed on a semiconductor material (10 in the Figure), the ohmic contact comprising a mixture of p-type semiconductor oxide and metal. As previously stated in the Response filed on 1/30/02, while not expressing an opinion about whether Howe discloses a p-type semiconductor oxide, Applicants respectfully submit that Howe's invention does not describe an ohmic contact in a semiconductor device formed on a semiconductor material, the contact comprising a p-type semiconductor oxide, as clearly stated in claims 8 and 16. Rather, Applicants respectfully submit that Howe discloses something similar to a Schottky contact, notwithstanding Howe's claims to the contrary (col. 9, lines 13-20).

The role of Howe's insulator layer 12 is described in detail in columns 7-11. Howe states that the insulator composition and thickness is chosen to permit transmission of light (col. 7, line 36) and the tunneling of electrons from the front face of the conducting layer 14 to the semiconductor layer 10 (col. 7, lines 56 - 62), while at the same time preventing the tunneling of dark current electrons from the semiconductor into the conductive layer (col. 7, line 68; col. 8, lines 1-4). The goal of this arrangement is to increase both the electrochemical photocell current and voltage (col. 8, line 4). The insulating layer of the Howe device, which arguably comprises a p-type semiconductor oxide, is essentially a diode in that it permits current flow in one direction. A diode has a non-linear I-V curve and cannot be equivalent to the ohmic contact of the instant invention clearly recited in claims 8 and 16.

Howe describes several ways of fabricating the insulator later 12. First, the base semiconductor 10 can be oxidized by exposure to air (col. 8, lines 34-51). Applicants point out that Howe largely limits this discussion to n-type semiconductors. Howe briefly mentions p-type semiconductor oxides to criticize them because they

cannot be formed at room temperature (col. 8, lines 37-39). Therefore, Applicants respectfully submit that Howe actually teaches away the use of p-type semiconductor oxide formed from the base semiconductor in his discussion thereof.

The second method of fabricating the insulating layer disclosed by Howe is to deposit a non-native insulating layer onto the semiconductor layer (col. 8, lines 55-65). Since this method actually deposits insulating materials onto the semiconductor, it does not disclose a p-type semiconductor oxide as recited in claims 8 and 16.

The final insulating material proposed by Howe is a doped insulator wherein dopants are added, for example, to the base semiconductor material before oxidization for form a p-type insulator (col. 9, lines 5-6). Although Howe states that the impurity is doped in the insulator layer to form a p-type insulator layer, the effect of the impurity induces the complimentary opposite charge in the semiconductor and enhances the voltage barrier at the interface (col. 10, lines 47 - col. 11, line 13). This is beneficial to the Howe application since it enables the photocell to achieve higher voltages (col 10, line 47). Increasing the voltage barrier associated with the insulating layer is equivalent to increasing its resistance. In contrast thereto the instant invention provides an ohmic contact. Since the contact on the instant invention is an ohmic contact, the p-type dopant doped in the semiconductor oxide increases the conductivity of the layer thereby deteriorating the voltage barrier associated therewith, rather than increasing the voltage barrier as in the Howe device.

As a final matter, Applicants respectfully submit that the Howe reference includes the phrase "ohmic contact" quite frequently when discussing the direct metal contact to the backside of the semiconductor layer. (See e.g, col 4, line 28). Nowhere, however, is the phrase "ohmic contact" used to describe the contact comprising a p-type semiconductor oxide. This would indicate that Howe's only conception of an ohmic contact is direct metal-to-semiconductor contact. This is precisely the type of contact for which the instant invention provides a low resistance alternative.

Since Howe does not disclose "an ohmic contact in a semiconductor device which is formed on a semiconductor material, the ohmic contact comprising a p-

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type semiconductor oxide and metal in a condition of mixed morphology" as clearly recited in claims 8 and 16, Applicants respectfully submit that claims 8 and 16 are allowable over Howe.

For the reason's mentioned above, it is Applicant's belief that claim 16 is allowable over the cited art. Insofar as claims 17-27 depend from claim 16, it is Applicants' belief that these claims are also allowable.

CONCLUSION

In view of the foregoing, Applicants believe all claims now pending in this Application are in condition for allowance. The issuance of a formal Notice of Allowance at an early date is respectfully requested.

If the Examiner believes a telephone conference would expedite prosecution of this application, please telephone the undersigned at 415-576-0200.

Respectfully submitted,

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VERSION WITH MARKINGS TO SHOW CHANGES MADE

8. (Twice Amended) An ohmic contact in a semiconductor device which is formed on a <u>p-type</u> semiconductor material, the ohmic contact comprising <u>a layer of</u> [mixture of] p-type semiconductor oxide and metal <u>in a condition of mixed morphology</u>.